Space Weather Technical Forecast

Issued on Thursday 16 January 2025 at 12:50 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with frequent low C-class flares, peaking C4.4 at 16/0726 UTC from AR3964 in the northwest. This region rapidly emerged in this period, and has continued to develop with the formation of a weak delta-spot. Slow growth has also been observed in the large region AR3959 in the northeast, and in AR3961 in the southeast, although these remain relatively magnetically simple. There are a seven sunspot regions on the disc, with the other regions smaller and simpler.

No Earth-bound CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: Ongoing fast wind influence was observed, from CH08/-. Solar wind speeds were mainly elevated, between 450-500 km/s, with brief peaks towards 550km/s. Density was average to below average. Interplanetary Magnetic Field, Bt, was Weak to Moderate, ranging 4-9nT. The north-south component, Bz, was Weak, ranging between +/- 7nT. Phi angle was generally negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES-18 was Background. High energy electron flux (greater than 2MeV) at GOES16 was Background to Moderate with the associated 24 hour fluence below the Active threshold. This reached 1.36e7 integrated pfu at 16/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with a chance of isolated M-class flares. There is a slight chance of an X-class flare.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Ongoing coronal hole influence is expected, with a transition from the fast wind of CH08/- to CH09/-, this then likely persisting for much of the period. Slightly elevated to elevated solar winds forecast, perhaps peaking days 2-3 (17-18 Jan). Mainly Quiet to Unsettled geomagnetic activity is expected with a chance of Active intervals on all days. There is a slight chance of reaching a G1 Minor Storm interval, perhaps slightly higher days 2-3 (17-18 Jan).

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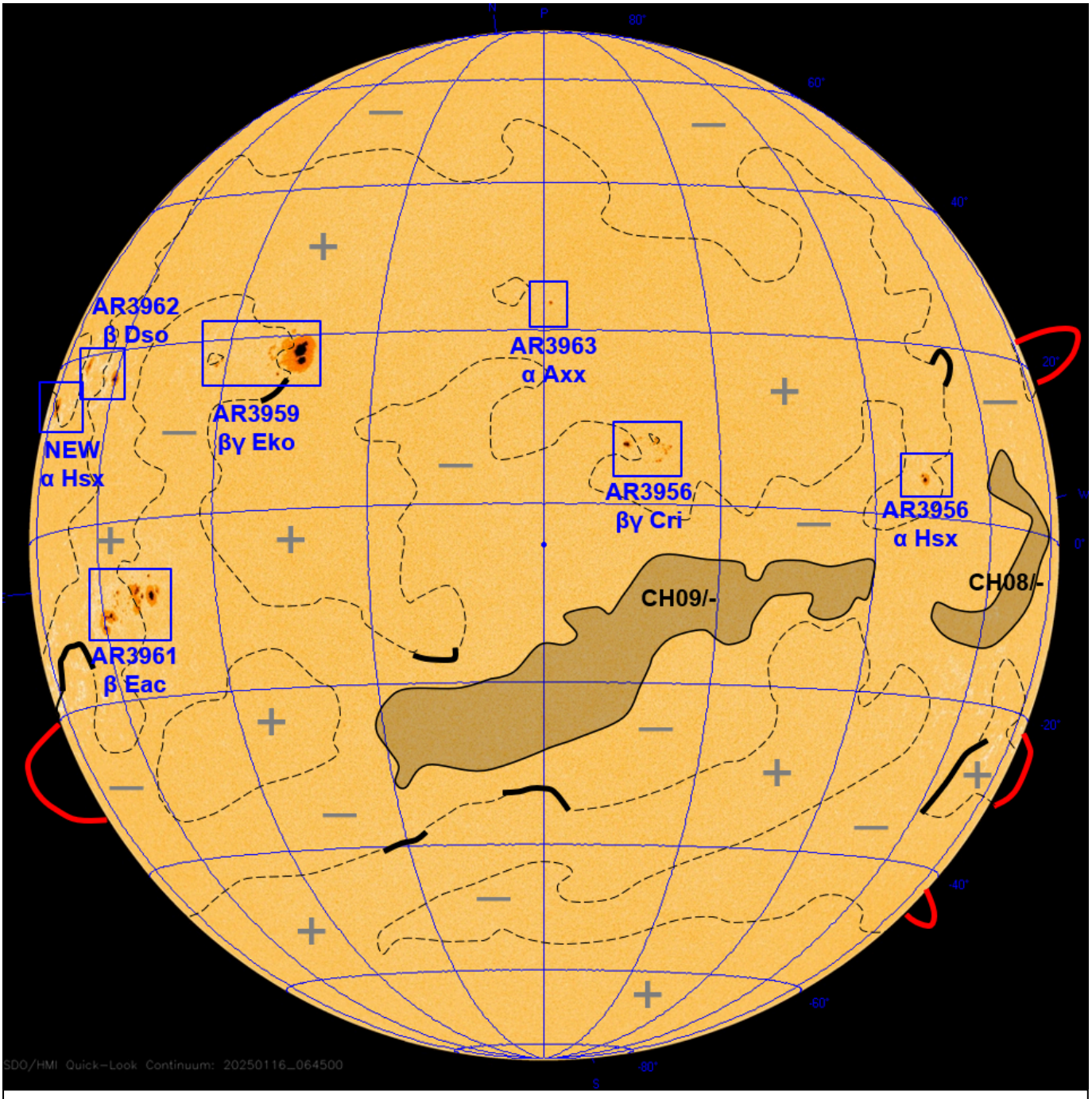
Energetic Particles / Solar Radiation: GOES18 high energy proton flux is expected to remain at background. GOES-16 high-energy electron flux is anticipated to be at Background with diurnal Moderate peaks, perhaps rising to High at times. The associated 24 hr fluence is expected to persist below Active (1e8 integrated pfu).

Figure 1: MOSWOC Solar Synoptic Map 16/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are no Earth-directed CMEs.

The solar wind outlook is dominated by the broad coronal hole across the central southern disc, CH09/-. Connection to this feature is likely to soon follow on from the ongoing enhancement from CH08/- which is now becoming harder to observe on the western disc, perhaps as early as late day 1 (16 Jan), but more likely through day 2-3 (17-18 Jan). Due the longitudinal width of this feature, ongoing fast wind influence is likely through the period, with slightly elevated (400-500km/s) solar winds expected, with a chance of strengthening to be elevated (500-600km/s) at times, most likely through days 2-3 (17-18 Jan).

This ongoing enhancement is supported in MOSWOC Enlil output, although this is perhaps over-estimating the longevity of the feature.

Overall Quiet to Unsettled conditions are expected with a chance of Active intervals on all days. There is a slight chance of reaching a G1 Minor Storm interval, perhaps slightly higher though days 2-3 (17-18 Jan).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	10	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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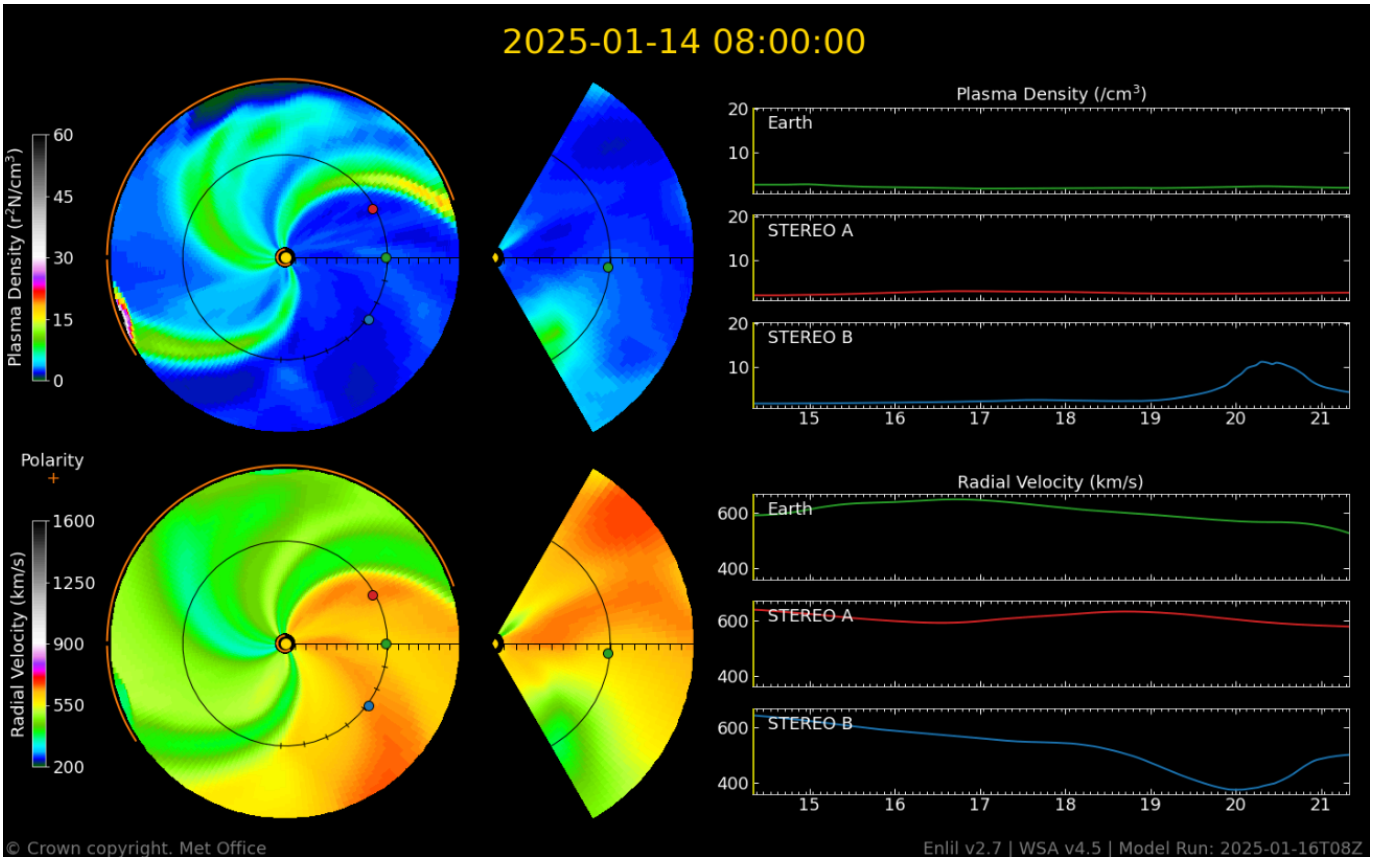
Figure 2: MOSWOC Enlil



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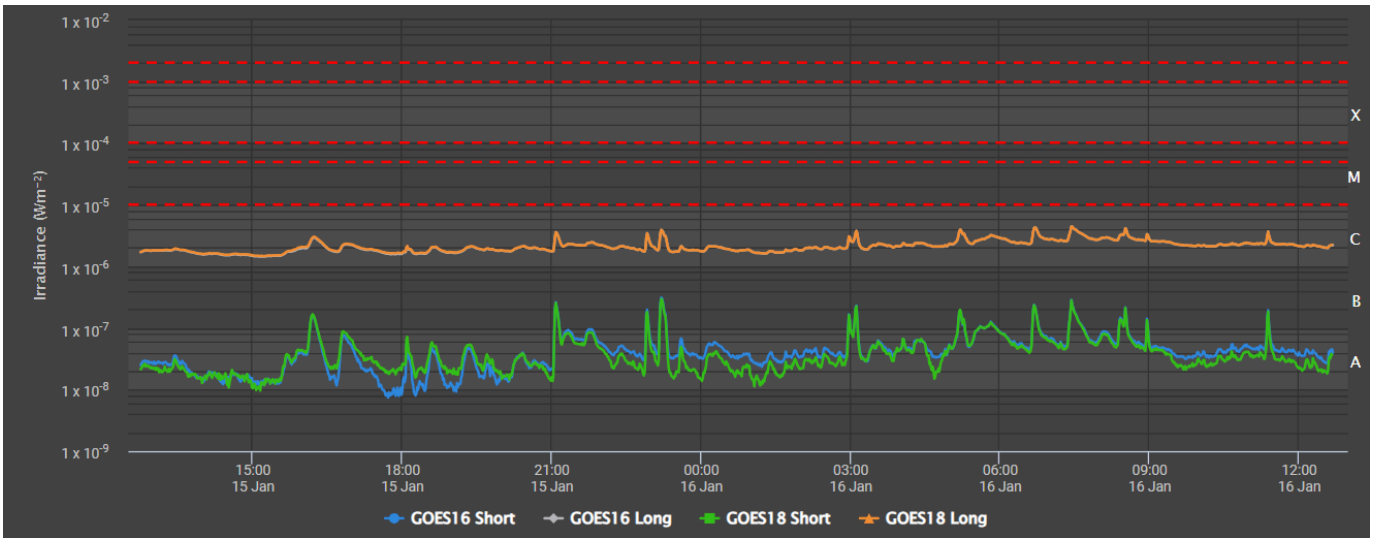
Radio Blackouts - X-Ray Flares

There are a number of sunspot regions showing some small growth across the disc, leading to a likelihood of isolated M-class flares.

The largest of these regions, AR3959 in the northeast, is dominated by a main leader spot but with some small development including a very small trailer spot. Recently numbered AR3964, northwest of the centre disc, is the most developmental region, rapidly emerging in the last 24 hours, with ongoing growth likely. This has also potentially developed a small delta spot. Also of interest in AR3961 in the southeast, which continues to slowly develop, with some consolidation of spots resulting in a number of individual spots with mature penumbra. The other spots are smaller and simpler.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	No	60	60	60	60
Very Active	R3-R5 (X Class)	No	10	10	10	10

Figure 3: GOES 16-18 X-ray Irradiance



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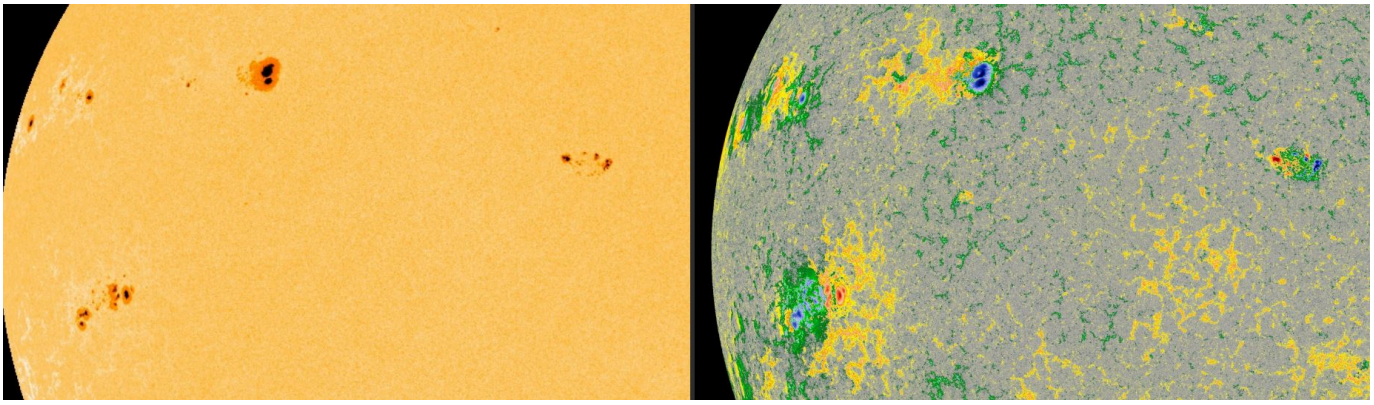
Solar Radiation Storms (High Energy Protons)

GOES18 high energy proton flux has remained at background over the last 24 hours and is expected to persist at this level. The main complexity on the disc is currently on the eastern disc, which is a less likely source location for proton events to be observed at Earth.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: SDO hmi and magnetogram imagery of the main sunspot regions currently on the disc



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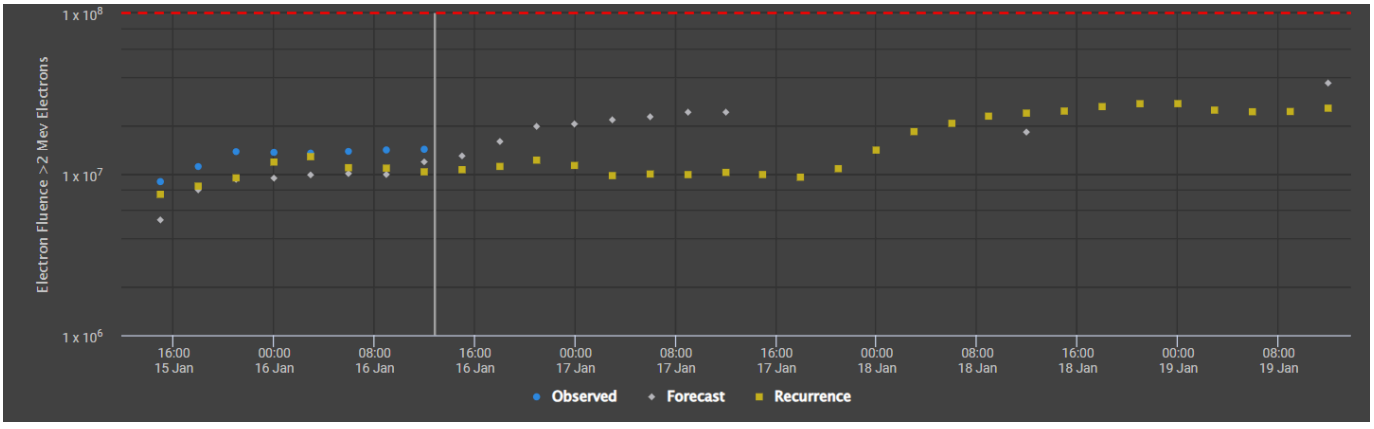
High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 is currently background to moderate. Ongoing coronal hole influences are likely to likely to lead to some charging of the Van Allen belts, but potentially result in the majority of this charge persisting below GEO. However, ongoing periods of Moderate flux are likely at diurnal peak, perhaps approaching High at times, most likely later in the period as any fast wind eases.

Overall, fluence is forecast to remain below Active, but may see a rising trend during the period. This is supported by the MOSWOC REFM model, although this is likely underestimating the likely rise.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	5	10
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 5: GOES 16 >2MeV Electron Fluence and MOSWOC REFM with 27-day recurrence



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